



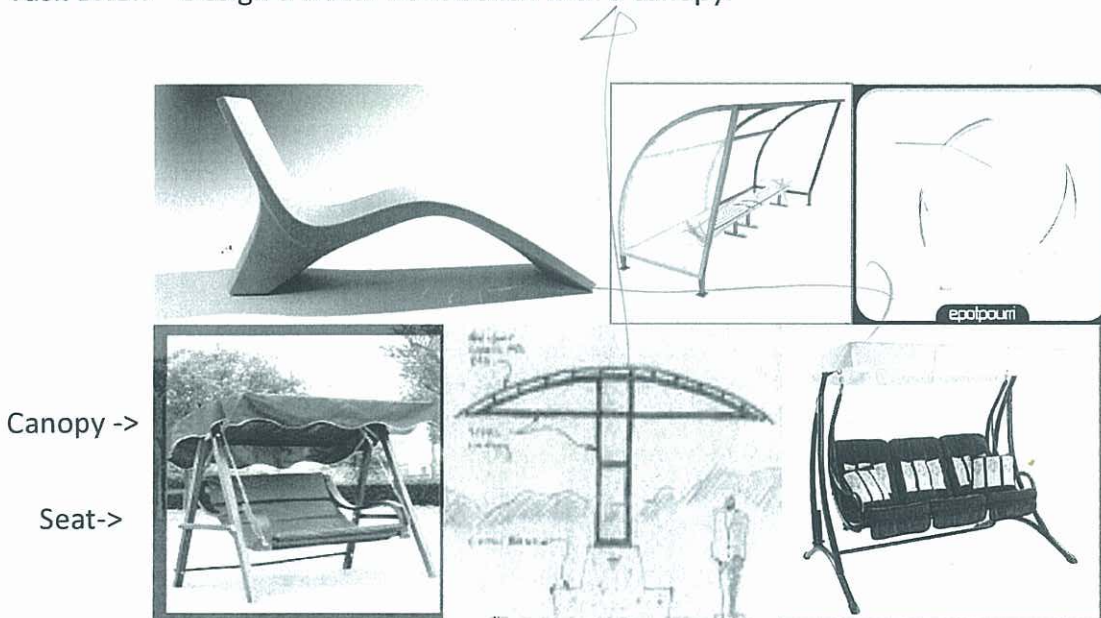
ASSESSMENT TASK

The water front bench

Subject:	Y10 Extended Mathematics	Name	Parco Cheung
		(Class):	(Y10H) Y10H
Topic:	Polynomials	Reading material:	Chapter 2 & 6 in Book A
Date of task assigned:	22 nd September, 2011	Due Date:	6 th October, 2011
Submission of task:	Please submit a print copy of the assessment to your Maths teacher on or before Thursday, 6 th October 2011 at 0840.		

This task assesses Criteria A, C, & D.

Task Brief: Design a water front bench with a canopy.

**ADVICE:**

Read the criteria descriptors and task-specific rubrics carefully before you start your work. This will give you a clear understanding of what is required and what a high quality piece of work for this task must include.

This way you give yourself the best chance of achieving the highest levels in this task.

Please attach these sheets to your final report.

The Task

* mention the range of x-axis

* remember to show where is the ground

Background

You have been hired as a new designer at the *Polynomial Seating Company (PSC)*. The company is world famous for designing and manufacturing creative and attractive seats and benches, mainly for outdoor use. The Manager is giving you a special task for a new client.

You are given the task of designing a chair/bench for use outdoors. The client wants your designs quite quickly. So does the manufacturing department of PSC, as they will want to start production quite soon.

The bench should be (a) comfortable, (b) suitable for keeping off the sun and the rain and (c) have a profile that is highly mathematical in shape – in fact it should use functions that you have met in this topic of Polynomials (i.e. quadratics and cubics).

Of course, you won't **build** the bench, but you will come up with the functions (equations) that will define the shape of the bench.

You will submit a report that outlines the development of your design. The report will be assessed using MYP Assessment Criteria A, C and D, and the paragraphs below expand on this.

Criterion A:

Here you show your **knowledge and understanding** of quadratic and cubic equations and their graphs. You **MUST** provide all the appropriate information about your design specification including:

- Accurate plots of all graphs, showing the important features of the design;
- Sets of equations describing all curves used and listing the **range of x-values**;
- The process (mathematics) by which you came up with the equations used in the design including possible modifications that could be made if requested by the client.

In order to score top marks in this criterion, you should show how you have used your knowledge in **unfamiliar situations** by embedding and developing at least one function that has not been covered in class, such as trigonometric, exponential, logarithmic etc.

→ sin, cos

Criterion C:

Your design needs to be **communicated** effectively for your manager, the client, and the manufacturing department who will use it to make the actual bench. This means that all graphs will be clearly labeled, and all appropriate diagrams and **charts will be explained**. Equations will have to connect sensibly to appropriate units of distance.

Any software used will have to be cited and, if necessary, explained.

Criterion D:

Before you begin your design, it is important that you come up with a set of **specifications** so the client can see how **comfortable**, **sheltered**, and **creative** your **design** will be. You need to **reflect** (and possibly research) on associated real-life issues, such as:

- People's sizes and comfort levels;
- How people sit or lounge;
- How the sun and the rain act;
- How easily the bench might be stored away;
- Any other features that you believe may be relevant to the product.

percentage error.

Once you have finished your design, please **evaluate** it against the specifications you listed before you began. Consider how well your model fits your specifications by checking the degree of accuracy (possibly percentage error or sig. fig.). Because the client wants the initial design in just a few days, there may well be a number of things you cannot do. If you had more time, suggest what other things you might do to improve your product? What different mathematical methods might you have tried?

$y=x^2$ ← mention first

→ reflection

→ other's opinion

Assessment Criteria for Y10 Extended Maths Bench Assessment

Criterion A		
Levels	Task-Specific Rubric	Official IB Descriptors
0	The student does not reach a standard described by any of the descriptors given below.	
1-2	The student generally makes appropriate selections of one or more simple functions (such as $y=mx+b$, $y=x^2$) and manipulates them in to form a chair/bench.	The student generally makes appropriate deductions when solving simple problems in familiar contexts.
3-4	The student generally makes appropriate selections of two or more non-linear functions (eg quadratics or cubics) and manipulates them to form a chair/bench with a canopy.	The student generally makes appropriate deductions when solving more complex problems in familiar contexts.
5-6	The student generally makes appropriate and accurate selections of three or more sophisticated functions (eg higher order polynomials, trigonometric functions) and manipulates them to form a chair/bench with a canopy.	The student generally makes appropriate deductions when solving challenging problems in a variety of familiar contexts.
7-8	The student consistently makes appropriate and accurate selections of four or more sophisticated (eg higher order polynomials or trig) functions and at least one unfamiliar one (eg circles, roots, exponentials, logs, hyperbolas etc) to form a chair/bench with a canopy.	The student consistently makes appropriate deductions when solving challenging problems in a variety of contexts including unfamiliar situations.

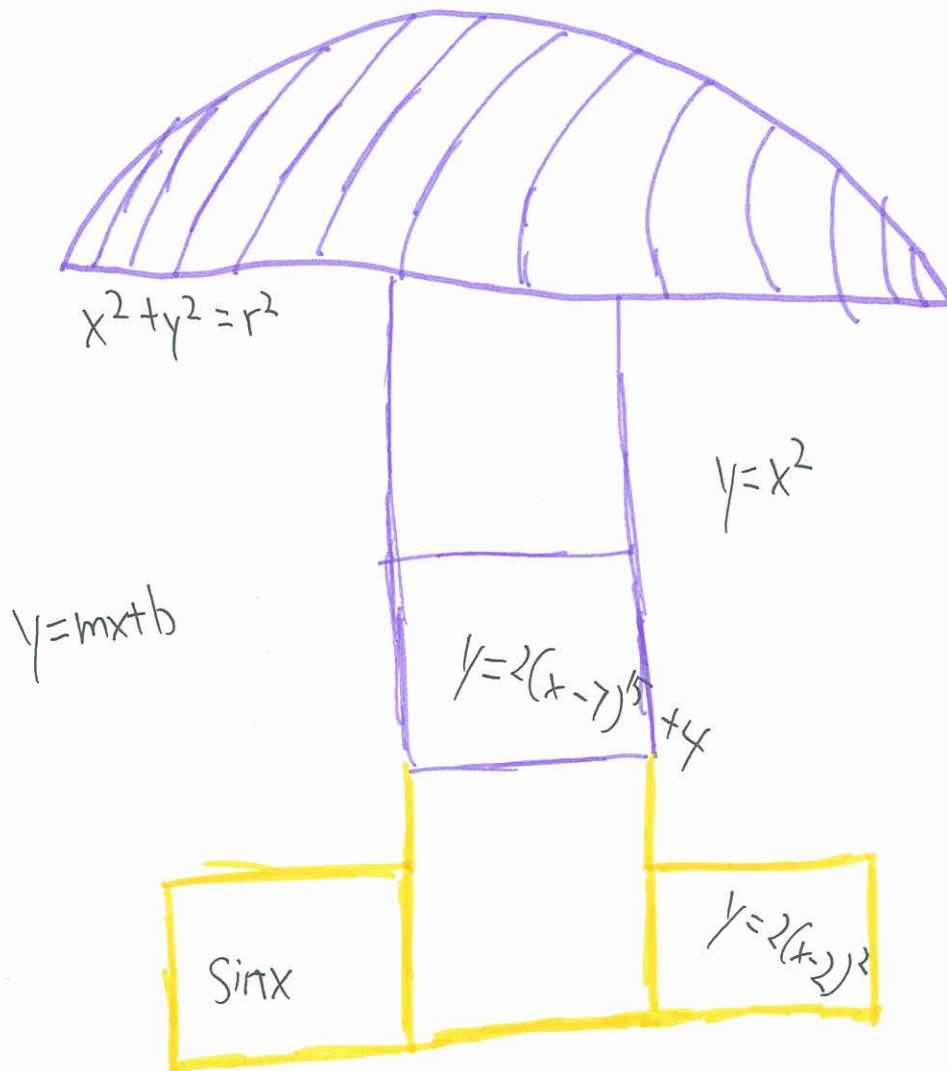
Criterion C		
Levels	Task-Specific Rubric	Official IB Descriptors
0	The student does not reach a standard described by any of the descriptors given below.	
1-2	Some very basic equations are offered and described. There are some appropriate diagrams and graphs. There is a basic narrative that describes the processes used.	The student shows basic use of mathematical language and/or forms of mathematical representation. The lines of reasoning are difficult to follow .
3-4	Equations used are generally clearly explained. Clear, accurate and relevant graphs, and/or charts and tables are provided. It is generally easy to see how these diagrams describe the development of the chair/bench design. Key vocabulary is used. Narrative is generally accurate.	The student shows sufficient use of mathematical language and forms of mathematical representation. The lines of reasoning are clear though not always logical or complete . The student moves between different forms of representation with some success .
5-6	Several graphs and diagrams are offered to show the development of the chair/bench. Graphs are accurate and detailed. Equations are provided which match the important features of the graphs. It would be possible for PSC engineers to produce the chair/bench from the diagrams. The narrative is very clear.	The student shows good use of mathematical language and forms of mathematical representation. The lines of reasoning are concise, logical and complete . The student moves effectively between different forms of representation.

Criterion D		
Levels	Task-Specific Rubric	Official IB Descriptors
0	The student does not reach a standard described by any of the descriptors given below.	
1-2	There has been a limited amount of relevant research undertaken. To some degree, the student has connected this research to the design of the chair/bench.	The student attempts to explain whether his/her results make sense in the context of the problem. The student attempts to describe the importance of his or her findings in connection to real life where appropriate.
3-4	The student has undertaken good, relevant research and has used this in the development of the chair/bench. The student has explained with justification how the design features of the chair/bench relate to real-life issues. The student tries to explain the accuracy of the equations.	The student correctly but briefly explains whether his/her results make sense in the context of the problem. The student describes the importance of his/her findings in connection to real life where appropriate. The student attempts to justify the degree of accuracy of his/her results where appropriate.
5-6	The student critically compares the final product with features identified at the design stage. Real-life issues associated with the design are developed. The student justifies appropriateness and accuracy of all equations and offers a critical review of the mathematical methods used, suggesting viable alternatives or improvements where appropriate.	The student critically explains whether his or her results make sense in the context of the problem. The student provides a detailed explanation of the importance of his/her findings in connection to real life where appropriate. The student justifies the degree of accuracy of his/her results where appropriate. The student suggests improvements to his/her method when necessary.

next Thursday = first Check point

Next Next Tuesday = check point 2

The water front bench

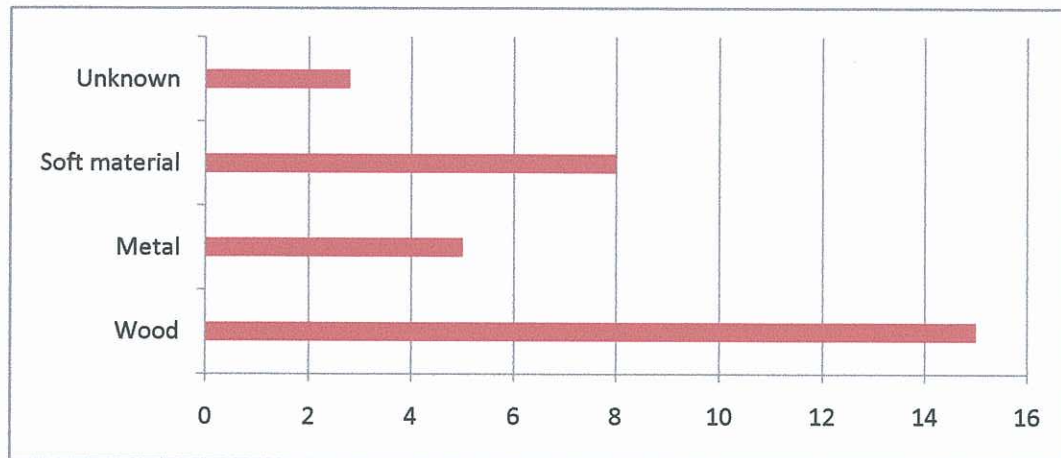


Parco Cheung

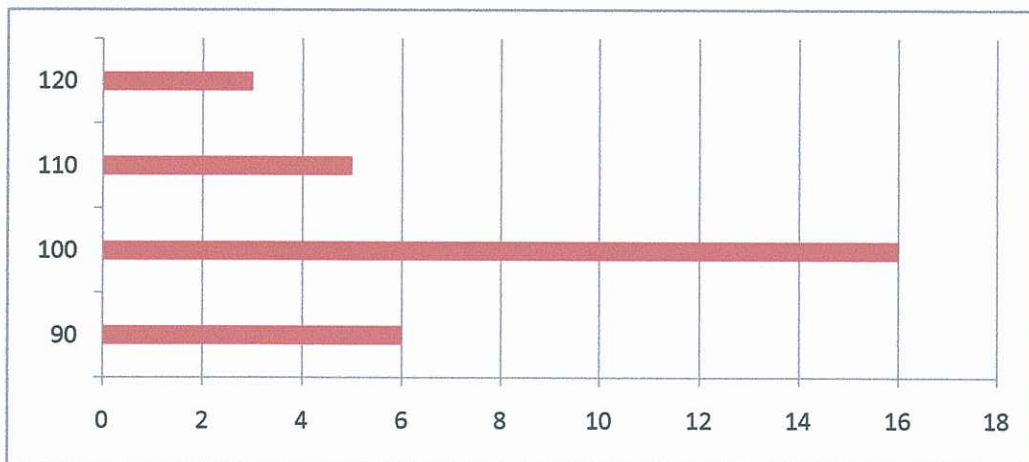
Y10 Hope

Ms. Li

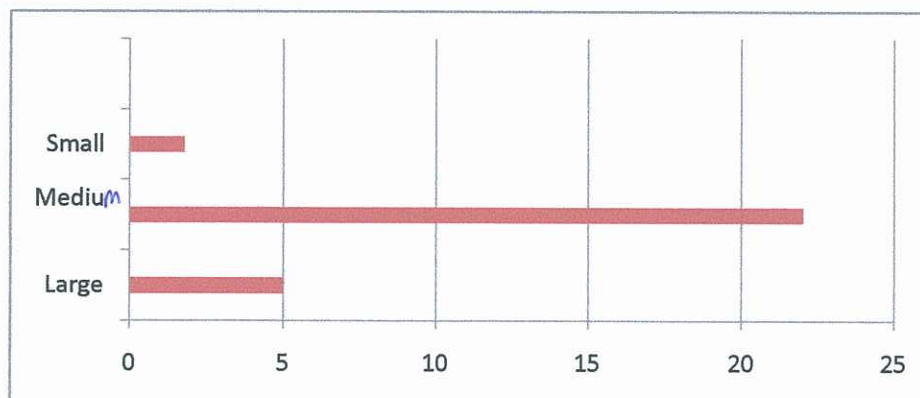
Q1 what kind of material do you prefer



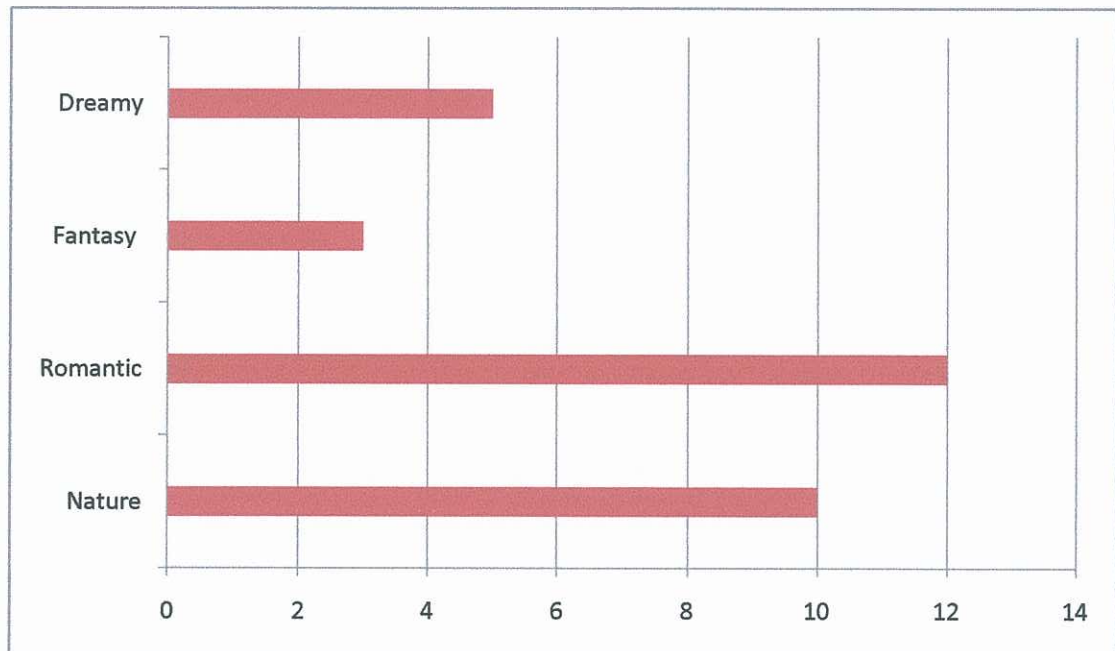
Q2 Which degree do you prefer the most for the bench?



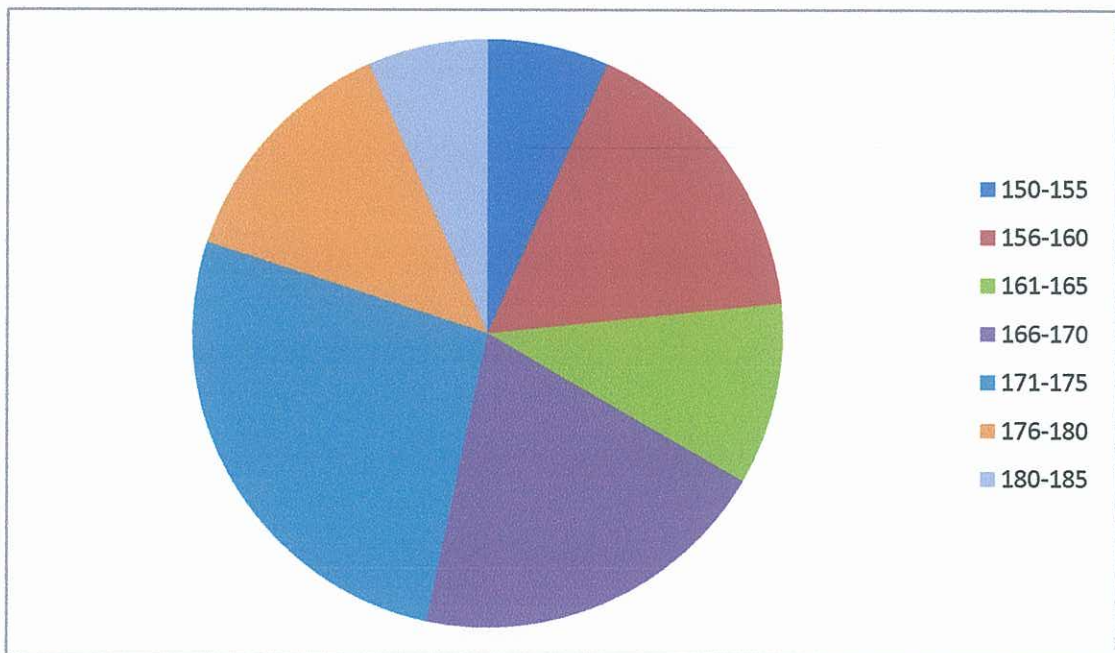
Q3 Which size of the bench do you prefer?



Q4 what theme of the bench do you prefer?



Q5 what is your height?



With the result given in the survey, it helps me to design my bench and canopy in height, theme, and also material.

Analysis for survey:

For my survey, I have set 5 questions which is already enough for the information. First of all, in my survey, most people prefer wood therefore I am going to use wood for the material. In many types of wood, I think that rosewood is the most suitable material.

Rosewood refers to any kind richly colored wood (timber). It is often in brown color and darker color. Majority of the rosewoods are tough and heavy, it has a good durability which commonly could be used for over decades. In general, rosewood is planted in Asia and South Africa. Products that are made from Rosewood are furniture, guitars, and billiard cues and chess pieces. Therefore for this project, I am going to use rosewood as the material to create my bench and the canopy.

For the second question, 16 decided that 100 degree is the most suitable degree for them. In a formal estimation in England, 10000 people are being interviewed and 27 percent of the people suffer from backache, therefore the correct angle of the bench is very important.

For the third question, most people think that the bench size should be in medium which symbolizes that they agree that the size of bench should only fit 2 people. Fitting 2 people in the same bench signifies a more romantic bench

For the theme of the bench, 12 people that are being interviewed suggest that the theme of romantic is probably the best. Therefore, for my design of bench and canopy, I will use the theme of romantic and use the colour of purple to perform this theme.

For the last question, it helps me to construct the height of the canopy as I have to be sure that no one will bump their head when they stand up therefore through the information of different people's height, I can make assumption for my canopy.



For this assessment, I am going to design a bench with a canopy. The bench that I design will be located at the water front. In addition, the design will be desirable to my customer. I have to fulfill a few aspects. First of all, the bench should be comfortable, sheltered and creative. In order to meet the above requirements, my product should have detailed specifications to guide my design.

For my design, the bench will be suitable for two people (usually couples) so it will be coloured "light purple" to make look romantic. In addition, the material that is used is rosewood as rosewood is a timber that is able to be long-lasting. Typical rosewood is hard to be ruined; even water can rarely damage it. Therefore, this kind of wood will be suitable for my client. In addition, my canopy will be designed as a universal shade canopy which can covers the entire bench to avoid bad weather such as rainy days and too shiny days. However, wind can enter from the sides. The canopy will be colored purple and red so it will fit the theme of romance and provide customers with a comfortable environment. As I have to consider normal people's heights, I have decided that the bench will be 40 cm high so that all teenagers and adults can sit on it easily and comfortably. The back of the bench is slightly inclined so that people sitting on it can arch back slightly in order to be more comfortable. Moreover, the legs of the bench can be fitted into certain dents which are 5 cm deep in the ground. In this way, it can be easily stored away as the bench can be lift up by two people and take it away. However, the canopy cannot be moved away as it is firmly affixed to the ground.

Specification:

- Practicality
The bench enables people especially couples to sit on and enjoy the view of the sea
The canopy can be used as a temporary shelter in case of rain and strong sunshine.
- Aesthetic qualities
Able to show the theme of romance by the colours themselves
Able to release the wood perfume from the bench (rosewood)
- Durability
Able to be long-lasting

- End-user

Any people, in particular, couples and lovers

If I have more time, I think that I should make my design more sophisticated so my bench can be more detailed. In addition, I think that if I have more time, I will have an absolute different design where my bench will be made up of two small benches so it will be easy to store away. If I have more time on my design, I will show my former design to more people so they can give me more advice for improvements. However, I have only asked my dad for any improvements therefore the comments and improvements of my former design are limited. Provided that I have more time, I will use functions of higher orders, log functions when designing my bench.

Critical specification

Design specification	Yes	No
The bench enables people especially couples to sit on and enjoy the view of the sea	Yes	
The canopy can be used as a temporary shelter in case of rain and strong sunshine.	Yes	
Able to show the theme of romance by the colour themselves	Yes	
Able to release the wood perfume from the bench (rosewood)	Yes	
Able to be long-lasting	Yes	
Any people in particular, couples and lovers	Yes	

1

Evaluate the specification



The design of my bench and canopy exactly matches my design specification. Therefore, my model will fit my specifications by 100 percent. However, there will be a percentage error of less than 1 percent in the supporting poles of the canopy as I am taking 3 significant figures instead of the full number. In addition, there will also be percentage error of less than 1 percent in the bench as I am also taking 3 significant figures only. Although my design will have some errors, it will not affect the structural safety of the bench and canopy as the errors are very small.

Scale 1cm = 10cm

Front view, draft 1

$$(x-h)^2 + (y-k)^2 = r^2$$

$$y = 19.5$$

$$y = 3x + 12$$

$$y = 15$$

$$y = 3x + 8$$

(h_4, k_4)

(h_3, k_3)

(h_2, k_2)

(h_1, k_1)

$$x = 12$$

$$x = 8$$

$$x = 7.5$$

$$y = (x - 3.25)^4 + 5$$

$$y = (x - 11)^4 + 5$$

$$x = 5$$

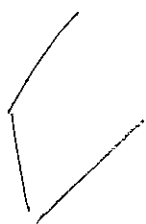
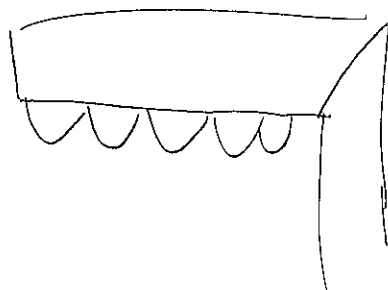
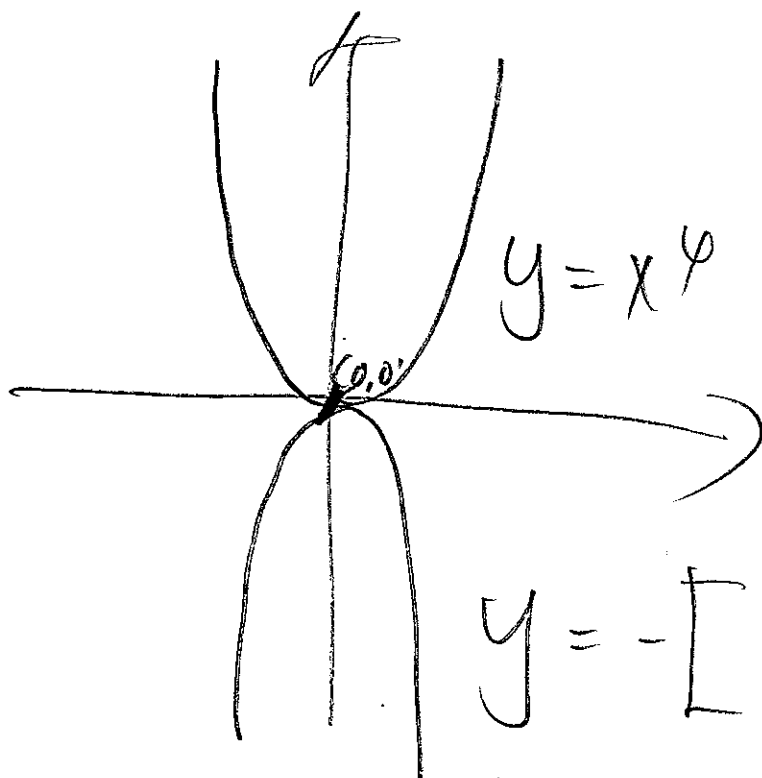
grand

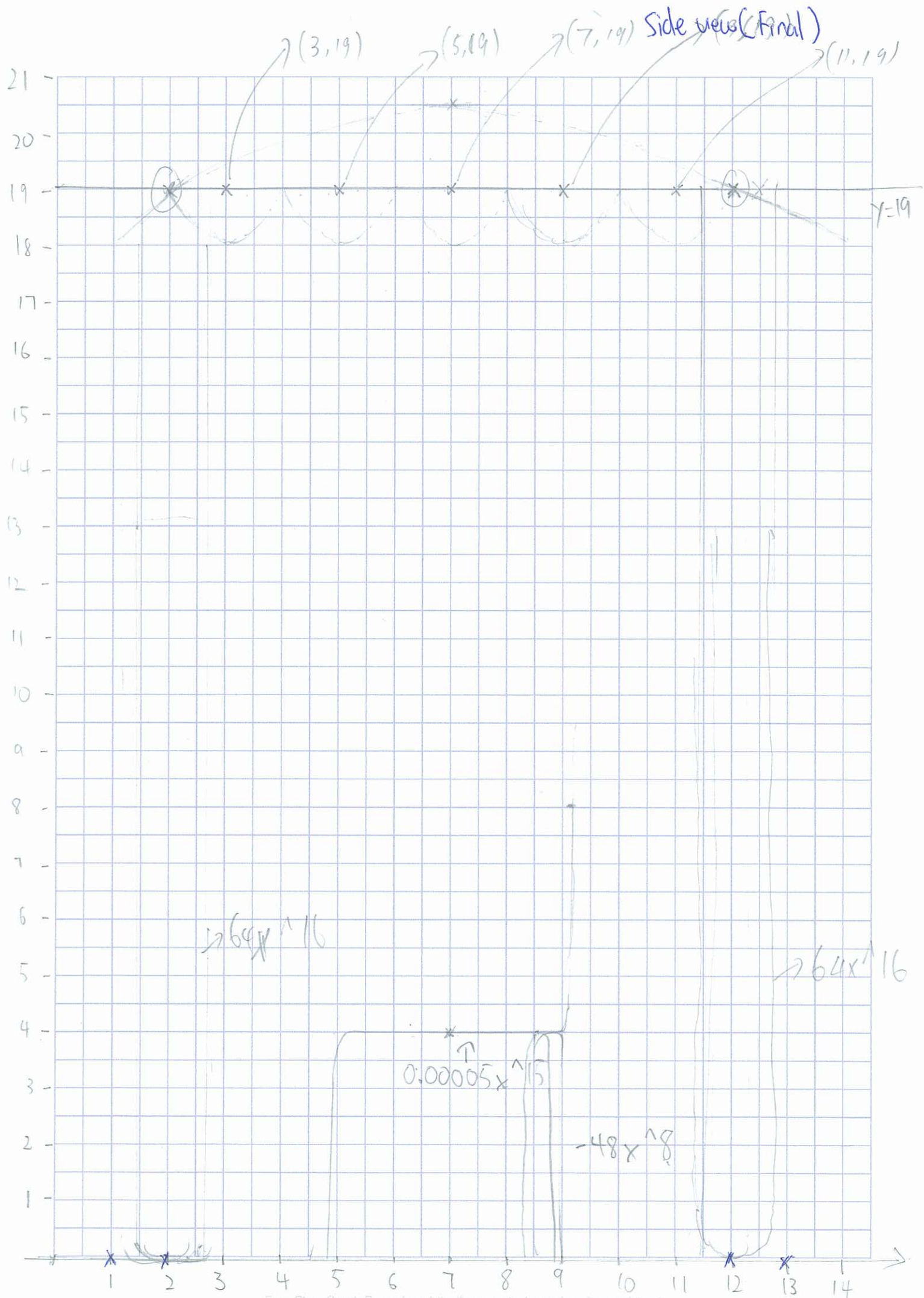
grand

1.5

3.25

percentage error





$$64x^{16} \longrightarrow 64(x-2)^{16}$$

$$64x^{16} \longrightarrow 64(x-12)^{16}$$

$$0.00005x^{15} \longrightarrow 0.00005(x-7)^{15} + 4$$

$$-48x^8 \longrightarrow -48(x-8.5)^8 + 4$$

$$y=19 \quad (x-3)^2 + (y-19)^2 = 1$$

$$(x-5)^2 + (y-19)^2 = 1$$

$$(x-7)^2 + (y-19)^2 = 1$$

$$(x-9)^2 + (y-19)^2 = 1$$

$$(x-11)^2 + (y-19)^2 = 1$$

$$(x-h)^2 + (y-k)^2 = r^2$$

~~$$y = -0.06(x-7)^2 + 20.5$$~~

$$y = -x^2 \longrightarrow y = -0.06(x-7)^2 + 20.5$$

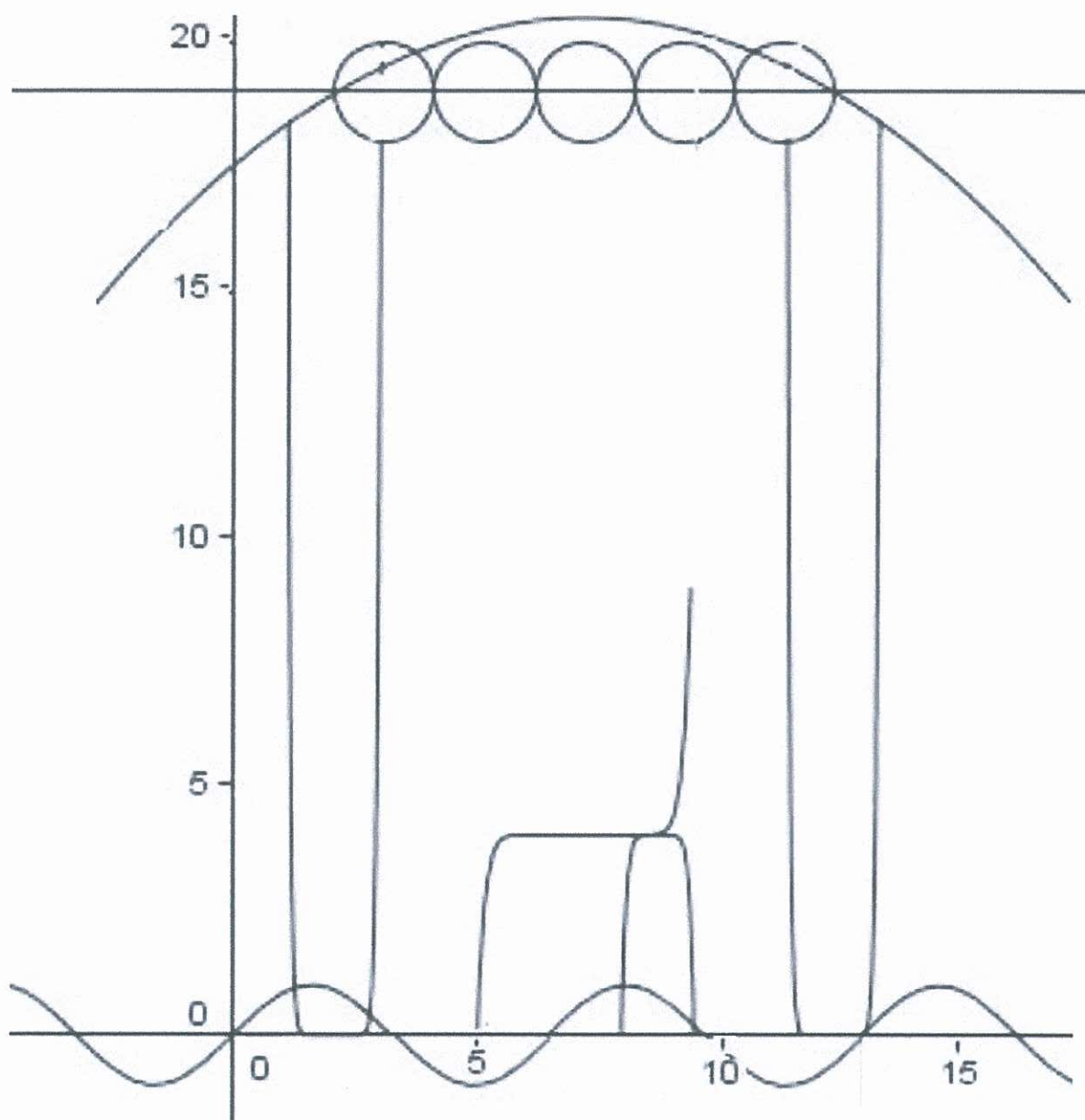
Function $[64(x-2)^8,$

6-solve

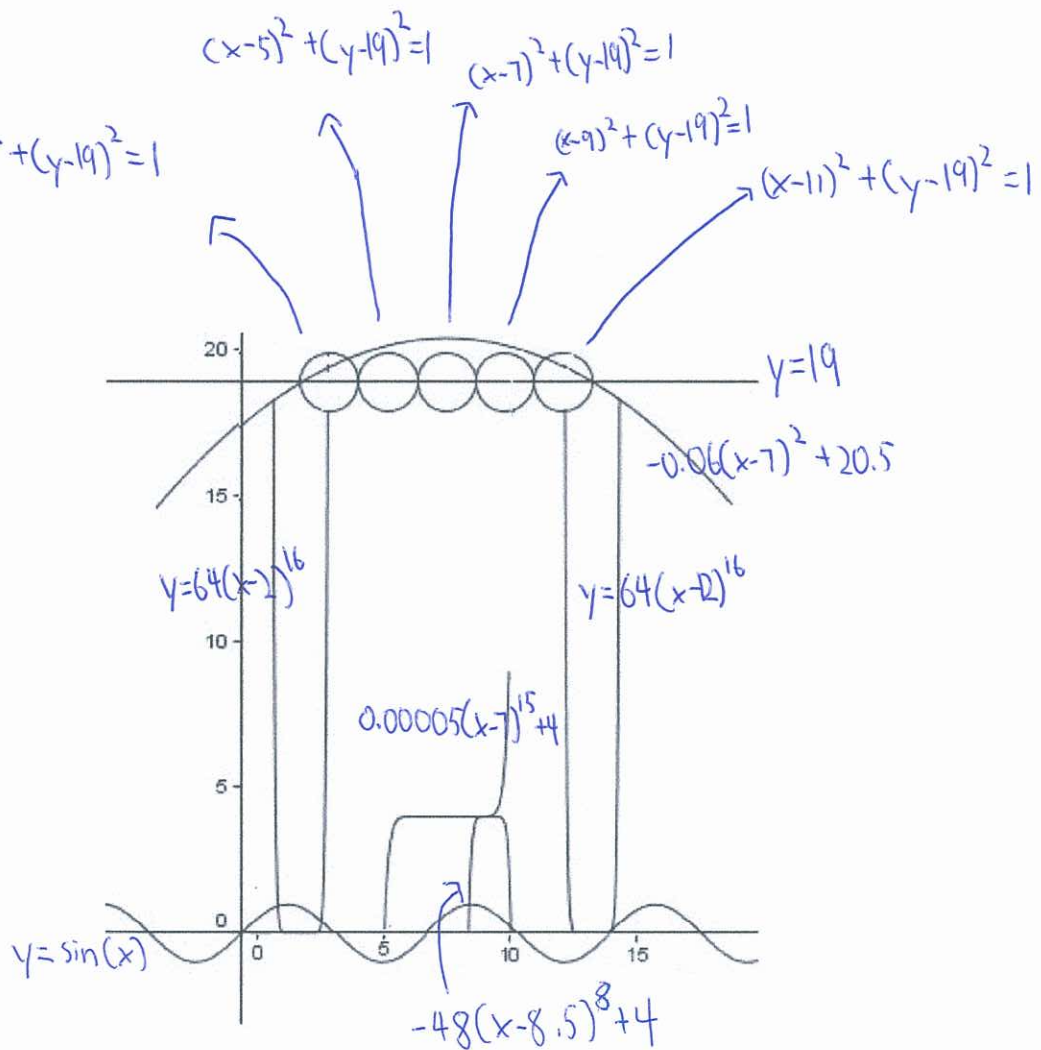
calculate x (x-cal)

$$y=18$$

If $x > 1.076220579$



The water front bench



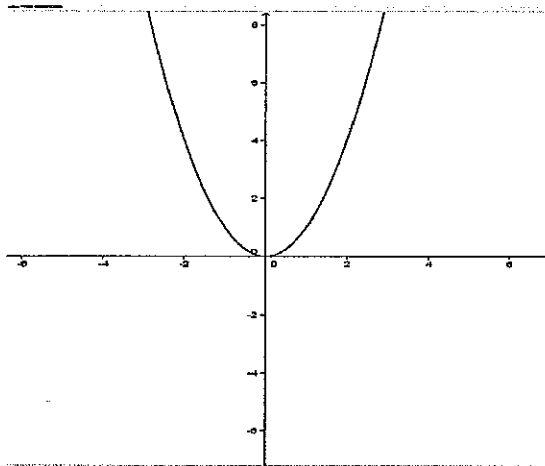
$y=0$ is the ground

Use of GeoGebra =

Url = www.geogebra.org/cms/en/download

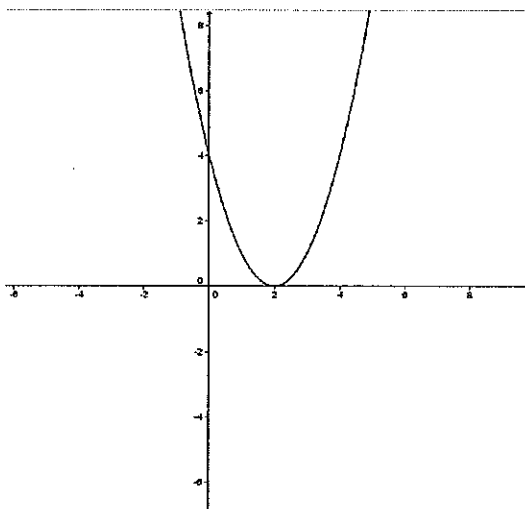
Explanation of the equations:

Equation1: $y=64(x-2)^{16}$



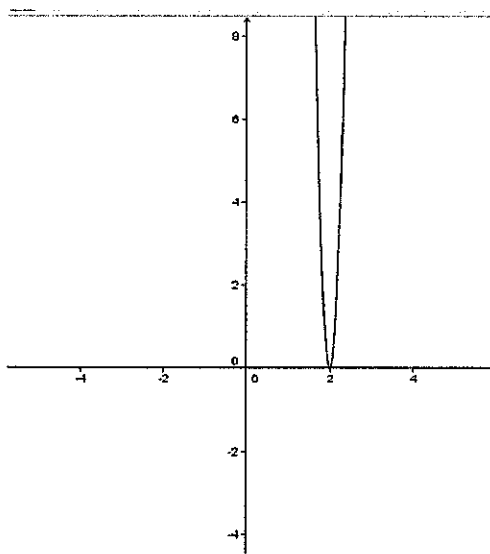
Step 1:

First of all, the set of Equations before transformation is $y=x^2$



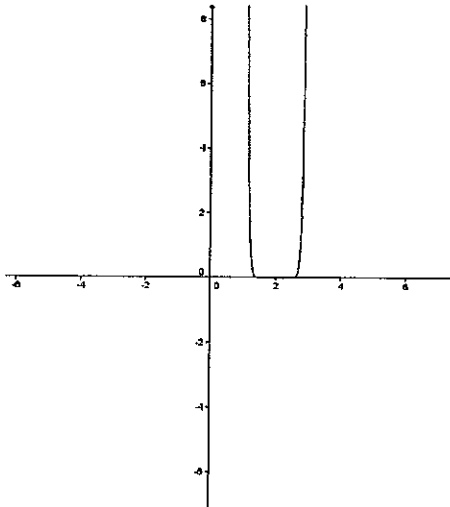
Step 2:

Second, I have Shift the equation to 2 units right which the equation is now $y=(x-2)^2$



Step 3:

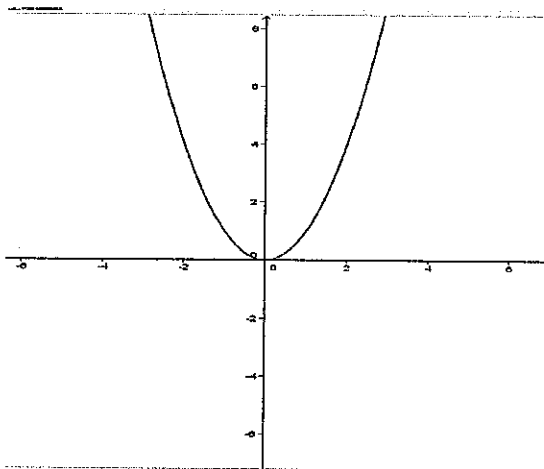
Thirdly, the parabola looks thinner on either side of the x-axis but not taller nor shorter. The equation is now $y=64(x-2)^2$



Step 4:

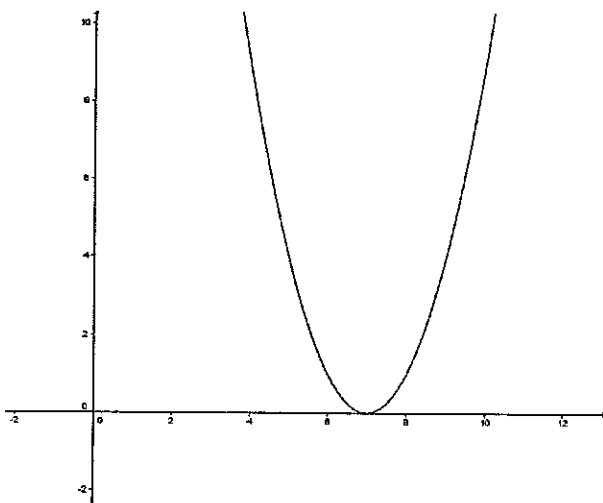
Fourth, the parabola becomes fatter of the axis with the same height. The equation is now $y=64(x - 2)^{16}$

Equation 2: $y=0.00005(x-7)^{15}+4$



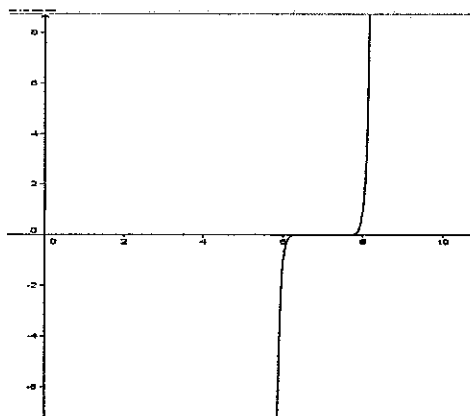
Step 1:

First of all, the set of Equations before transformation is $y=x^2$



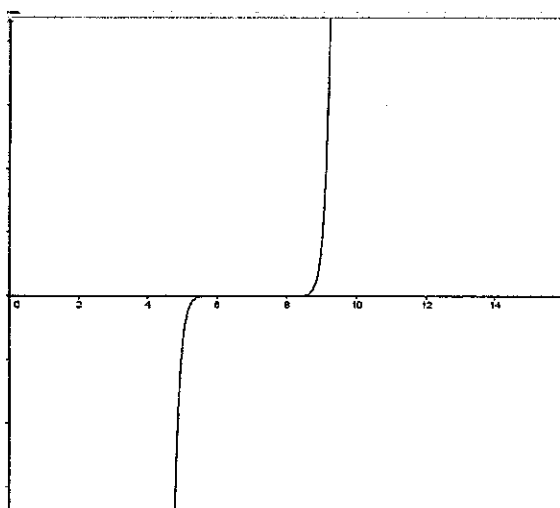
Step 2:

Second, I have Shift the equation to 7 units right which the equation is now $y=(x-7)^2$



Step 3:

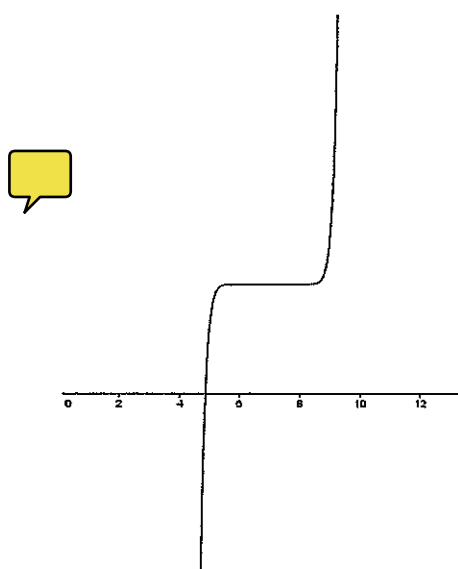
Third, the as the number of the power is a odd number, the shape of the polynomials become the shape as shown on the left. The equation is now $y = (x-7)^{15}$



Step 4:

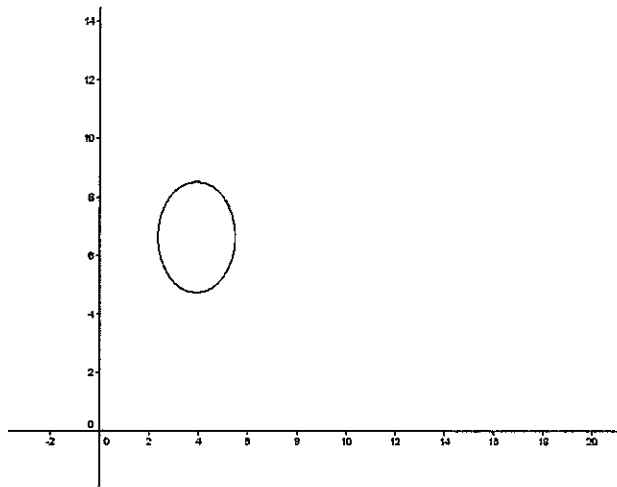
In order to widen the polynomial, I have added a number in front of $(x-7)^{15}$.

Now, the equation of the polynomial is $0.00005(x-7)^{15}$



Step 5:

In order to rises my polynomial by four units upwards, my new equation is $0.00005(x-7)^{15}+4$.



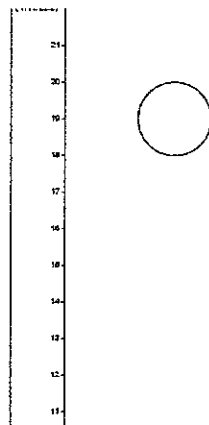
Equation 3: $(x-3)^2 + (y-19)^2 = 1$

The formula of a circle is

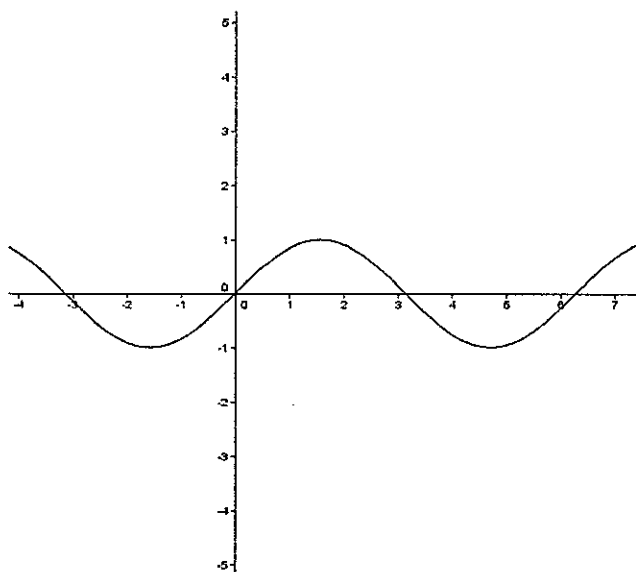
$$x^2 + y^2 = r^2$$

In this case, if we expand the standard equation of circle, we have $(x-h)^2 + (y-k)^2 = r^2$, where h is the x-value and k is the y value.

Equation 3: $(x-3)^2 + (y-19)^2 = 1$



In the sets of Equations, I have insert my x and y value which is 3,19 and formed the circle in the correct place. This is my equation $(x-3)^2 + (y-19)^2 = 1$



Equation 4: $\sin x$

This equation is $\sin(x)$ and as you can see; this is the basic equation and is also the equation after transformation as no more shifting is necessarily.

Sets of Equations Before transformation	Sets of Equations after transformation	Range of x-values
$y = x^2$	$y = 64(x-2)^{16}$	$1.5 \leq x \leq 2.5$
$y = x^2$	$y = 64(x-12)^{16}$	$11.5 \leq x \leq 12.5$
$y = x^2$	$y = 0.00005(x-7)^{15}+4$	$5 \leq x \leq 9$
$y = x^2$	$y = -48(x-8.5)^8+4$	$8.5 \leq x \leq 9$
$y = 19$	$y = 19$	$2 \leq x \leq 12$
$x^2 + y^2 = 1^2$	$(x-3)^2 + (y-19)^2 = 1$	$2 \leq x \leq 4$
$x^2 + y^2 = 1^2$	$(x-5)^2 + (y-19)^2 = 1$	$4 \leq x \leq 6$
$x^2 + y^2 = 1^2$	$(x-7)^2 + (y-19)^2 = 1$	$6 \leq x \leq 8$
$x^2 + y^2 = 1^2$	$(x-9)^2 + (y-19)^2 = 1$	$8 \leq x \leq 10$
$x^2 + y^2 = 1^2$	$(x-11)^2 + (y-19)^2 = 1$	$10 \leq x \leq 12$
$y = x^2$	$y = -0.06(x-7)^2 + 20.5$	$-2.55 \leq x \leq 17.55$
$y = \sin x$	$y = \sin x$	$-5 \leq x \leq 18$


Process

Draw the curves which correspond with different algebraic functions. Place the curves at appropriate positions by the skills of transformation of curves as well as enlargement or reduction of curves.



Scale: 1 unit to 10 cm

Different types of colour



Red usually means power and aggressive. This color has the use to make a room full of power and will energetic the user.

Pink symbolizes love and romance, therefore this kind of colour will be suitable for a peace and calm atmosphere.

Yellow means happiness and friendship. Using the colour of yellow will enable the room become more sunshine and the user will be more delightful.

Blue is a peaceful colour. Using this colour will enable the room to be more natural and the user will be calmer.

Orange is a colour symbolizing warm and energy. Through this colour, the atmosphere of the room will be more enthusiastic.

Green is a colour symbolizing nature and spring. This colour brings a heavy feeling however it also makes the end user to feel that it, generosity, fertility, jealousy, inexperience, envy, misfortune, vigor.

Therefore, I am going to use purple as I am going to bring the theme of romance in my design of bench.

